Department
for Environment
Food & Rural Affairs

Pest specific plant health response plan:

Outbreaks of *Aromia bungii*

Figure 1. Adult *Aromia bungii*. © Fera Science Ltd.

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This publication is available at

https://planthealthportal.defra.gov.uk/pests-and-diseases/contingency-planning/

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Executive summary

Background	
Regulation	GB Quarantine pest
Key Hosts	*Prunus* spp.
Distribution	China, Democratic People's Republic of Korea, Germany, Italy, Japan, Mongolia, Republic of Korea, Russia, Vietnam
Key pathways	Plants for planting, Wood packaging material
Industries at risk	Amenity, garden centres, nurseries, wider environment
Symptoms (2.3)*	Inhibited fruit development, premature leaf drop, dieback and host mortality
Surveillance	
Demarcated zones (5.33-5.38)	Infested zone = 100 m around known infested plants Buffer zone = ≥ 2 km
Surveillance activities (5.39-5.48)	• Visual surveys will be carried out in the infested and buffer zone • Pheromone trapping surveys • Regular surveillance of sentinel trees • Suspicious symptoms found by ground surveys may be followed up by tree climbers if required
Response measures	
Interceptions (5.1-5.7)	• Infested consignments should be destroyed or re-exported • Tracing exercises carried out where required • UKPHINS notification made
Outbreaks (5.49-5.58)	• Infested plants, plants showing symptoms and susceptible hosts within 100 m of infested plants should be felled and removed • Restrictions on the movement of host plants and plant products from demarcated areas • Plants and hedgerows to be cut to ground level • Planting of trap trees for monitoring purposes
Key control measures	
Biological	N/A
Chemical	Insecticides are unlikely to prevent spread
Cultural	Felling and destruction of infested trees, Trapping, Trap trees
Declaration of eradication	
Eradication can be declared if no pest is detected during annual surveys for eight years after the infested material was destroyed.	

* Numbers refer to relevant points in the plan

Contents

1. Introduction and scope 5
2. Summary of threat 5
3. Risk assessments 6
4. Actions to prevent outbreaks 7
5. Response 7

   Official action to be taken following the suspicion or confirmation of *Aromia bungii* on imported plants 7

   Official action to be taken following the suspicion of an *Aromia bungii* outbreak 9

   Confirming a new outbreak 10

   Criteria for determining an outbreak 12

   Official Action to be taken following the confirmation of an outbreak 13
6. Criteria for declaring eradication / change of policy 21
7. Evaluation and review of the contingency plan 21
8. Appendix A 22

   Data sheet for *Aromia bungii* 22
9. References 7
10. Authors and reviewers 12

1. Introduction and scope

1.1. This pest specific response plan has been prepared by the Defra Risk and Horizon Scanning team. It describes how the Plant Health Service for England will respond if an infestation of *Aromia bungii* (red-necked longhorn beetle) is discovered.

1.2. The plant health authorities of Northern Ireland, Scotland, Wales and the Crown Dependencies have been consulted on this plan and will use it as the basis for the action they will take in the event of *A. bungii* being detected in their territories.

1.3. This document will be used in conjunction with the *Defra Generic Contingency Plan for Plant Health in England* (https://planthealthportal.defra.gov.uk/assets/uploads/Generic-Contingency-Plan-for-Plant-Health-in-England-FINAL-2.pdf), which gives details of the teams and organisations involved in pest response in England, and their responsibilities and governance. It also describes how these teams and organisations work together in the event of an outbreak of a plant health pest.

1.4. The aims of this response plan are to facilitate the containment and eradication of *A. bungii* and to make stakeholders aware of the planned actions.

2. Summary of threat

2.1. *Aromia bungii* is native to eastern Asia, in China, the Democratic People's Republic of Korea, the Republic of Korea, Taiwan and Vietnam (CABI, 2017). The beetle was also confirmed in Japan in 2013, in the Aichi Prefecture, and has since spread into Tokyo and at least 5 other prefectures (The Japan News, 2017). Outside of Asia, evidence of breeding populations of this beetle were discovered in 2011 in Kolbermoor, Germany, and in 2012 and 2013 in the Campania and Sedriano Regions of Italy, respectively (EPPO reporting service, 2012a, b, 2013c). The beetle was found again in Kolbemoor in 2016, in the Campania Region in 2017 and a new finding in the Lazio region of Italy in 2020 (EPPO reporting service, 2021). Eradication activities continue in both countries (EPPO reporting service, 2017a, b).

2.2. It is the larvae of *A. bungii* that are the damaging life stage of this species as they are woodboring pests of *Prunus* spp., including *P. armeniaca* (apricot), *P. avium* (cherry), *P. domestica* (plum) and *P. persica* (peach) (Gressitt, 1942; Liu *et al.*, 1999; EPPO reporting service, 2013a). *Aromia bungii* has also been recorded on other tree species, including *Populus* spp. (poplars), but these are mostly from compilation host lists without any supporting evidence, and require further confirmation.

2.3. Larvae bore galleries underneath the outer bark and intothe sapwood and heartwood of their hosts, resulting in inhibited fruit development, early senescence and dieback, and eventually the death of plants (EPPO, 2014; CABI, 2017).

2.4. Feeding damage and the death of trees impacts the economy, with respect to reduced yield, the environment, with respect to the loss of ecosystem services, and society, with respect to declining recreational and amenity sites (CABI, 2017; The Japan News, 2017).

2.5. Although *Prunus* plants for planting (*A. bungii*'s main hosts) are prohibited from being introduced into Great Britain pending a risk assessment, there is an exemption from this requirement for plants originating in EU Member States, Liechtenstein and Switzerland. There is therefore potential for *Prunus* plants from the EU to become a pathway for the pest to reach the UK. Larvae and pupae within wood and wood packaging is also another possible pathway, even though hosts of *A. bungii* are not commonly traded as wood or wood packaging, except for *Populus* spp., such as *Populus alba*, which is an unconfirmed host (Anderson *et al.*, 2013; EPPO, 2014). Although ISPM 15 requires that imported wood packaging material is treated to kill wood boring pests, longhorn beetles have been regularly intercepted from Europe, other Asian countries, Africa, Australasia and the Americas(Eyre and Haack, 2017). *Aromia bungii* can hitch hike. In 2007 a beetle was found in an empty sea container in Blaine, Washington, USA, (EPPO, 2014), and in 2008 three adult beetles (two live and one dead) were found in a warehouse in Bristol, UK amongst imported wooden pallets, and within a manufacturing plant in Seattle, Washington, USA, without any indication of damage (Smith, 2009; Anderson *et al.*, 2013; EPPO, 2014).

2.6. There has been only one interception to date of *A. bungii* in the UK (as mentioned in point 2.5).

3. Risk assessments

3.1. *Aromia bungii* has an unmitigated and mitigated UK Plant Health Risk Register score of 60 and 36, respectively. Overall scores range from 1 (very low risk) to 125 (very high risk). These scores are reviewed when new information becomes available (https://planthealthportal.defra.gov.uk/pests-and-diseases/uk-plant-health-risk-register/viewPestRisks.cfm?cslref=26575).

3.2. Pest risk analyses have been carried out by Germany, the UK, and EPPO (Schrader and Schröder, 2012; Anderson *et al.*, 2013; EPPO, 2014).

3.3. Based on these pest risk analyses, *A. bungii* is considered likely to establish across the EPPO region, particularly in Macaronesia (Canary Islands, Azores, Madeira, and Cape Verde), Portugal and the Mediterranean Basin. For the UK, establishment is likely in the south, but may be limited in northern parts. The economic impact in these regions could be considerable, especially on *Prunus* spp. around the Mediterranean and Black Sea. Environmental and social impacts may also be significant.

4. Actions to prevent outbreaks

4.1. *Aromia bungii* is a GB Quarantine Pest (Schedule 1 of The Plant Health (Phytosanitary Conditions) (Amendment) (EU Exit) Regulations 2020) and is therefore prohibited from being introduced into, or spread within GB. Further pest and host specific requirements are listed in Schedule 7. *Aromia bungii* is also a GB Priority Pest meaning it is a GB quarantine pest which has been assessed to have the most severe potential economic, environmental and social impacts to GB.

4.2. *Aromia bungii* is an EU Union Quarantine Pest (Annex II Part B (Pests known to occur in the Union Territory) and is therefore prohibited from being introduced into, or spread within the Union Territory.

4.3. *Aromia bungii* is an A1 listed pest for the EPPO region and is therefore recommended for regulation by EPPO member countries.

4.4. The Plant Health Service should be aware of the measures described in this plan and be trained in responding to an outbreak of *A. bungii*. It is important that capabilities in detection, diagnosis, and risk management are available.

5. Response

Official action to be taken following the suspicion or confirmation of *Aromia bungii* on imported plants

5.1. If *A. bungii* is suspected by the Plant Health and Seeds Inspectorate (PHSI) or Forestry Commission (FC) to be present in a consignment moving in trade, the PHSI or FC must hold the consignment until a diagnosis is made. Samples should be sent to Fera Science Ltd., Plant Clinic, York Biotech Campus, Sand Hutton, York, YO41 1LZ (01904 462000), or Forest Research, Alice Holt Lodge, Wrecclesham, Farnham, GU10 4LH (0300 067 5600), in a sealed bag or container,

within at least two other layers of containment, which are not liable to be crushed during transit. Damaged eggs, larvae or pupae should be submitted in tubes of 70% ethanol to prevent further degradation if possible. In instances where either live beetles or signs of live beetles is confirmed, the inspector shall determine the level of plant health risk in the circumstances considering the weather conditions, the time of year and the likelihood of the pest escaping and order the appropriate remedial action. This may involve, if possible, the reloading of material back into the freight container and closing the doors or requiring the consignment be covered to reduce the risk of insect escape.

5.2. When an infestation of *A. bungii* is confirmed, the PHSI or FC should advise the client of the action that needs to be taken by way of an official plant health notice. The consignment should be destroyed by either wood chipping, incineration or deep burial.

5.3. Where there is a high risk of escape before destruction, fumigation and/or foliar insecticides may be used under guidance from the Defra Risk and Horizon Scanning team.

5.4. A UKPHINS (UK Plant Health Interception Notification System) notification should be made upon confirmation of an interception of live *A. bungii*. UKPHINS is the IT system for recording findings and non-compliance in order to maintain records and notify other National Plant Protection Organisations (NPPO) of plant health issues.

5.5. If all or part of the consignment has been distributed to other premises prior to diagnosis, trace forward and trace back inspections should take place upon suspicion or confirmation of *A. bungii*. Details of recent past and future consignments from the same grower/supplier should also be obtained.

5.6. A pest alert to raise awareness of *A. bungii* and its symptoms should be distributed to packers/processors and importers where *A. bungii* has been found, and to those in the local area and those associated with the infested premises. A pest alert is available on the Plant Health Portal - https://planthealthportal.defra.gov.uk/. For finds of *A. bungii* when the chances of establishment are minimal, such as on imported materials at ports or inland within a warehouse, surveillance should be carried out if there is deemed to be a high risk of spread. This should include monitoring within a radius of at least 1 km around the finding for at least one life cycle of the beetle plus an additional year or at least four years. Surveillance during the first year will be more regular and intensive. Surveillance of *Prunus* spp. in subsequent years should be carried out once per year in spring on publicly accessible land, with the level of surveillance undertaken dependent on the location and the circumstances of the initial finding.

5.7. Finds of *A. bungii* in the wider environment will need to be treated as suspect outbreaks and investigated as per point 5.8.

Official action to be taken following the suspicion of an *Aromia bungii* outbreak

5.8. Suspect outbreaks will be assessed on a case by case basis. An Outbreak Triage Group (OTG), chaired by the Chief Plant Health Officer (CPHO) or their deputy and including specialists from APHA, Defra and other organisations, should be set up to assess the risk and decide on a suitable response. Where appropriate, the OTG will also decide who will be the control authority, and the control authority will then nominate an incident commander. An Incident Management Team (IMT) meeting, chaired by the incident commander, will subsequently convene to produce an Incident Action Plan (IAP) to outline the operational plan. See the *Defra Generic Contingency Plan for Plant Health in England* for full details.

5.9. The OTG will set an alert status, which will consider the specific nature of the outbreak. These alert levels, in order of increasing severity, are white, black, amber and red (more details on these levels can be found in table 2 of the *Defra Generic Contingency Plan for Plant Health in England*). Under most scenarios, an outbreak of *A. bungii* suspected in a tree is likely to be given an amber alert status. An amber alert status refers to a serious plant pest/disease with potential for relatively slow, but extensive geographical spread leading to host death and/or major economic, food security or environmental impacts.

Restrictions on movement of material

Wood packaging material

5.10. If *A. bungii* is suspected to have emerged from, or found infesting, Wood Packaging Materials (WPM) at an inland site, all the WPM from the same consignment and any other potential sources of infestation should be placed on hold pending further investigation.

Nursery, orchard or garden centre

5.11. If *A. bungii* is detected or suspected to be present in a nursery, orchard or garden centre, all host plants and suspect material should be placed on hold pending further investigation.

Wider environment

5.12. If *A. bungii* is detected, or suspected to be in a tree, or is found free living in the wider environment, all wood material within a radius of 100 m should not be moved out of the 100 m zone pending further investigation on a precautionary basis.

Preliminary trace forward / trace backward

5.13. If an infested consignment or tree is considered as being the source of the suspect outbreak, investigations regarding the origins of infested consignments will be undertaken to locate other related and therefore potentially infested consignments of products, WPM or trees moving to and from the site. If applicable the relevant NPPO should be contacted. For findings in the wider environment, where no trace forward or backward can be done, the most likely source should be identified and investigated.

Confirming a new outbreak

How to survey to determine whether there is an outbreak

5.14. Information to be gathered by the PHSI or FC on the suspicion of an infestation of *A. bungii*, in accordance with ISPM 6; guidelines for surveillance (https://www.ippc.int/en/publications/615/):

- The origin of the trees.
- Any information on the original source of the pest.
- Details of other premises or destinations where the trees have been sent, where the beetle may be present.
- The layout of the premises and surrounding area (in relation to potential buffer zones), including a map of the fields/cropping/buildings, at risk growers, and details of neighbouring trees, especially any commercial or non-commercial hosts in orchards, parks or gardens.
- Details of the tree variety, growth stage, dimensions (diameter or girth at breast height, approximate height), age/maturity and general condition.
- Description of the surrounding habitat, including all hosts (species and approximate size).

- Area and level of infestation, including life stages and a description of symptoms (photos would be helpful). Symptoms would include oviposition pits by adults, crown dieback, and larval tunnelling within the wood.
- The location of any known populations, including grid references.
- The date and time the sample was taken, and by whom.
- Current treatments/controls in place e.g. chemical treatments.
- Details of the movement of wood and WPM, people, equipment, machinery etc. to and from the infested area.
- Cultural and working practices.
- The name, address, email and telephone number of the person who found the pest and/or its symptoms.

5.15. This information should be included on the plant pest investigation template.

5.16. Further to information gathering, samples of other *A. bungii* infested wood should be taken to confirm the extent of the infestation e.g. in surrounding gardens, parks etc. This initial survey will be used to determine if it is an incursion or an established outbreak.

5.17. Finance for the surveys will depend on the individual circumstances of the outbreak, and will be subject to discussion, usually between Defra policy, the PHSI and FC.

Sampling

5.18. Any eggs, larvae, pupae or adults found during inspection, survey or tree removal operations, should be submitted by the PHSI or FC to Fera Science Ltd. or Forest Research as in point 5.1.

5.19. Where a tree is suspected to contain *A. bungii*, destructive sampling will be required for confirmation, including the removal of the bark to reveal young larvae and tunnelling, and cutting through the trunk to reveal deeper galleries within the sapwood and heartwood. This may require the use of contractors.

5.20. Traps baited with sugar, vinegar and wine have been used in Italy to varying degrees of success and may be used to monitor for the adult beetle during its summer flight period (EPPO, 2014).

Diagnostic procedures

5.21. There are no morphological keys that will allow the positive identification of the eggs, larvae or pupae of most species of longhorn beetles including *A. bungii* and its subspecies *A. bungii cyanicornis* Guérin-Méneville, 1845

5.22. Adults can be identified to the family Cerambycidae using Booth *et al.* (1990) or Duff (2012), and confirmed to the genus *Aromia* using Bense (1995). Identification to species i.e. separating *A. bungii* from the native musk beetle *Aromia moschata* (Linnaeus, 1758) is based on the following differential characters:

- *Aromia bungii* (Figure 1 and 2): Length: 22-38 mm Elytra uniform, shiny, non-metallic, jet black; surface smooth and with no obviously raised elytral intervals. Pronotum uniformly red but black in the subspecies *cyanicornis*. Apical margin of the elytra with a dense fringe of short black hairs. All body appendages are black. Under-surface of the body almost entirely smooth, some sparse hairs.

- *Aromia moschata* (Figure 2): Length: 13-34 mm Elytra uniform, dull, metallic but variable in colour between individuals from blue, green, copper, violet and rarely black; surface entirely wrinkled and with one or two obviously raised elytral intervals. Apical margin of the elytra with a sparse fringe of short dark brown hairs. All body appendages are metallic dark green, blue or black. Under-surface of the body densely covered with fine dense white hairs

5.23. Morphological identification can also be supported by DNA sequencing for all developmental stages, as verified reference sequences are available in public access databases, such as GenBank, for comparative purposes.

Criteria for determining an outbreak

5.24. An outbreak will be declared if there is confirmed evidence that *A. bungii* has established a population within host trees in England, other than any hosts that the pest may have arrived in from outside of the UK. For example:

- Confirmed immatures stages found within, or an adult beetle found on WPM with or without being associated with a fresh exit hole. will not be declared an outbreak of *A. bungii*.

- Any confirmed life stages or evidence of infestation e.g. if a fresh exit hole is found on a tree anywhere in England, it will be declared an outbreak of *A. bungii*.

Figure 2. *Aromia bungii* (left (length 22-38 mm)) and *Aromia moschata* (right (length 13-34 mm)) © Fera Science Ltd.

Official Action to be taken following the confirmation of an outbreak

5.25. The scale of the outbreak will determine the size and nature of the IMT and action.

Communication

5.26. The IMT will assess the risks and communicate details to the IPPC and EPPO, in accordance with ISPM 17: pest reporting (https://www.ippc.int/en/publications/606/), as well as within government to Ministers, senior officials and other government departments, devolved administrations and agencies (e.g., the Environment Agency) on a regular basis as appropriate; and to stakeholders.

5.27. Information on the outbreak will be communicated to residents and businesses outside the infested zone using various media formats e.g. leaflets, official posters, articles in local newspapers, appropriate websites, local radio etc. Consideration should also be given to the use of social media such as a 'Facebook' or 'Twitter' pages where members of the public can post questions relating to the outbreak.

5.28. Prepared material including a pest alert and factsheet is already available on the UK Plant Health Information Portal (https://planthealthportal.defra.gov.uk/), and information on the Observatree website (https://www.observatree.org.uk/portal/red-necked-longhorn-beetle/).

5.29. When an outbreak is considered likely to have a limited public impact e.g an outbreak in a nursery surrounded by a low urban density or in an urban area where there are few host plants resulting in limited felling activity, APHA or FC's media and communication teams will coordinate external communications as appropriate. When an outbreak occurs in an area that is likely to cause significant media and public interest, e.g., an inner city nature reserve/public park with a high density of trees that require felling, external communications will be coordinated through the Defra Press Office. In all cases, the Defra Press office must be kept informed of the current status of the outbreak and any action taken.

5.30. Depending on the scale and circumstances of the outbreak, a public meeting may be required to inform local residents and relevant stakeholders of the surveillance and eradication programme.

5.31. A communication plan should involve all the following elements:

- Stakeholder/message matrix: the Stakeholder/message matrix sets out the list of stakeholders likely to be affected by any outbreak, the order in which they should be contacted, the timescale and method for contacting them, and who they should be contacted by.

- Lines to take: outlining the main messages that should be put across to the public.

- Frequently Asked Questions (FAQ's): A list of FAQ's considered likely to be asked by the media and members of the public and model responses will be developed for staff as a reference source should they face such questions. A version of the document for public dissemination will be made available electronically via the appropriate website.

Demarcated zones

5.32. Once an outbreak has been confirmed, a demarcated area should be established around known infested trees. This will include two zones:

- The **infested zone**, where the presence of *A. bungii* has been confirmed, and includes all the plants showing symptoms caused by *A. bungii* and, where appropriate, all plants belonging to the same lot at the time of planting. As a minimum, the radius of this zone will extend to 100 m around all known infested plants.

- The **buffer zone** will initially extend to at least 2 km from the infested zone, with the exact delimitation being based on the biology of the beetle; the level of infestation; the distribution of host plants and evidence of establishment. Following surveys, it may be appropriate to reduce this area to within 1 km of the infested zone if the eradication of the beetle is considered possible by the IMT.

5.33. Initial maps of outbreak sites should be produced by officials.

5.34. All *Prunus* spp., and if feasible all other potential host plants, within the infested and buffer zone should be surveyed for signs of the beetle (see 5.38-5.47).

5.35. If it is considered possible that the beetle has been spread to other destinations, such as those with a history of receiving potentially infested trees or wood from within the demarcated area e.g., firewood merchants or local authority green waste disposal sites, then these areas should be surveyed. These zones should be treated as if they are part of the buffer zone.

5.36. The demarcated area should be adjusted in response to further findings. If *A. bungii* is found within an area outside the infested zone, this should also be designated as infested, and the demarcated areas adjusted accordingly.

5.37. The PHSI or FC will contact garden centres, nurseries, and other traders of host plants, as well as owners/managers/tenants of woodland areas, conservation areas and amenity land such as parks, within the demarcated areas to inform them of the requirements that will apply to them (see Pest Management Procedures). Controls on the movement of specified plants or wood will be implemented either by statutory plant health notices, or by a statutory instrument, or a combination of the two, depending on the nature and scale of the incident. The location of any demarcated areas will be published on '.gov.uk' to inform all other stakeholders (including residents, businesses and landowners) within the demarcated areas of the requirements that will apply to them.

Surveillance

5.38. All *Prunus* spp., and ideally all other potential host plants (see Appendix A), should be surveyed in the buffer zone. Hosts nearest to the infested zone should be surveyed first, with decreasing priority as the distance increases from the infested zone. The area closest to the infested zone may be surveyed by a systematic survey of all host plants and plant products, and the rest may be surveyed by surveying just *Prunus* spp. (high risk hosts). The areas to be surveyed systematically and by surveying only high risk hosts will be determined by the IMT.

5.39. A selection of sentinel trees will also be surveyed on a more regular basis, ideally at least three times per year (in spring, summer and winter). These will be single or groups of trees of the most favoured hosts of *A. bungii* selected to have a representation across the demarcated area. These trees could be selected on a circular route around the outbreak site (based on public pathways or other convenient routes), thereby providing a balance between being representative and accessible.

5.40. Inspection of trees should be of the whole plant. Trunks within 30 cm of the ground are preferred oviposition sites for the beetle, but adults will also lay eggs up to 2 m up the trunk and in the bark crevices of branches (Wu and Li, 2005; CABI, 2017). Hosts will initially be surveyed by inspectors from the ground with the aid of binoculars. Tree climbers may also be used, as they can spot symptoms that would not be possible to detect from the ground. A decision on when and where to use tree climbers will be made by the IMT.

5.41. Trunks and branches of all diameters should be inspected, but with a preference for branches of 3 cm or more; branches of 3 cm have been attacked in China and is the lowest diameter recorded, and branches of 10 cm are more commonly attacked (EPPO, 2014). These should be inspected for exit holes (Figure 3).

5.42. The base of trunks and the surfaces of branches could also be inspected for signs of frass (Figure 2). Although, the PHSI's experience of surveying trees for frass in Kent, 2012, for *A. glabripennis* was that the process was slow and inefficient, so this inspection method should be reviewed following initial surveys.

5.43. Traps baited with pheromones if available, or sugar, vinegar and wine may also be used to capture adults during the summer flight period.

5.44. If suspicious symptoms are seen on host plants, as well as non-host plants, that cannot be dismissed as being likely to be due to another cause, destructive sampling may be required to confirm infestation by *A. bungii*, including the removal of the bark to reveal young larvae and tunnelling, and/or cutting through the trunk or

branches to reveal deeper galleries within the sapwood and heartwood (Ostojá-Starzewski, 2016).

5.45. Surveys will be carried out annually and will continue until no beetle has been detected for at least four consecutive years. These surveys will be carried out by ground surveyors and tree climbers where deemed appropriate by the IMT, with a specific survey plan developed based on the outbreak situation.

5.46. The first surveys of the demarcated area will be carried out as soon as possible after the outbreak has been discovered. Subsequent surveys will be carried out between the end of winter and the beginning of summer as this is considered the best time of the year to detect symptoms of the beetle.

5.47. To aid surveillance, trees to be inspected or which have been inspected can be mapped using GIS software or similar.

Pest Management procedures

5.48. The movement of host plants and plant products (e.g. wood from pruning activities and wood packaging) out of or within the demarcated area should be restricted. However, they may be allowed movement if the conditions in Annex 7 of The Plant Health (Phytosanitary Conditions) (Amendment) (EU Exit) Regulations 2020 (points 80 (plants for planting), 140 (wood and WPM) and 141 (wood chips, particles, sawdust, shavings, wood waste and scrap)) can be met.

5.49. All infested plants and plants with symptoms of the beetle, as well as all suitable host plants within a radius of at least 100 m of any plant or plant product found to be infested should be cut down and removed. There is no data on the dispersal capacity of *A. bungii*, and its dispersal capacity is therefore based on other cerambycids, particularly *A. glabripennis*. There is evidence showing that *A. glabripennis* can fly further than 100 m and up to 203 m (Straw *et al.*, 2016). Hosts are also likely to be more sporadic for *A. bungii* (due to it having fewer hosts) than *A. glabripennis*, meaning that it could have to travel further to find a suitable host. *Anoplophora glabripennis* is less inclined to disperse if it is associated with a decent sized suitable host and may re-infest this host until it becomes unsuitable, a behaviour which may differ to *A. bungii.* Therefore, felling of preferred hosts further than 100 m should be considered. This would depend on the outbreak situation (including the extent, age and source of the outbreak) and host distribution in and around the infested zone, including whether the outbreak is located on a planting site. If infested plants are found outside the flying period for the beetle, the felling and removal should be carried out prior to the start of the next flying period, but ideally within a short space of time to allow the felled trees to be checked for further signs of infestation, which could lead to the need to fell additional trees.

- The removal of host plants will remain the responsibility of the occupier or other person in charge of the premises. Contact information for the Arboricultural Association with their register of qualified tree surgeons and ConFor (Confederation of Forestry Industries) will be provided to enable landowners to identify qualified operatives to carry out removal work. In exceptional circumstances, the removal of trees and shrubs may be carried out by the PHSI or FC.

- In the case of private householders, officials may agree to organise the felling and removal of host trees and shrubs, with responsibility for payment of costs remaining with the occupier or other person in charge, or for it to be undertaken by the relevant local authority which will be responsible for determining whether to accept responsibility for the costs of the work or seek recovery. Exceptionally, officials may, in the interests of speed, arrange for the work to be carried out and bear the cost, and where possible seek recovery after the event.

5.50. The radius of the areas described may be adjusted to reflect the density of potential and favoured hosts and the number of beetles, larvae and exit holes that have been found.

5.51. In exceptional cases where the IMT concludes that felling is inappropriate, an alternative eradication measure may be applied offering the same level of protection against the spread of *A. bungii*.

5.52. Plants and hedgerows should be cut as close as possible to ground level. The cut surface should be examined for signs of *A. bungii* activity. If signs are found then the stumps should be ground down to a level at which no symptoms are seen or, alternatively, the stumps should be dug up.

5.53. If the removal of stumps could cause unacceptable damage, fine mesh may be used to cover the stumps to prevent the escape of any remaining beetles, and to prevent any re-infestation (van der Gaag *et al.*, 2010; Roselli *et al.*, 2013). The IMT will advise this on a case-by-case basis.

5.54. All felled trunks and branches should be cut into sections of a size that can be easily turned over and examined by inspectors before disposal. The outside of the logs and cut ends must be examined for any signs of *A. bungii* damage. This could include exit holes and frass. Damage that is considered to potentially be caused by *A. bungii* should be checked by cutting thin slivers of wood away from the surface to reveal whether there is any tunneling below, and/or splitting the wood open with a hand axe. An alternative to cutting open suspect logs in the field is to transfer them to a laboratory or other facility set up to carry out this task. If this option is taken, then the logs need to be transported within three layers of containment and the laboratory/other facility needs to be licensed to hold such materials.

- Although time consuming, this may yield valuable information, including the extent and age of an outbreak.

5.55. The possibility of using foliar insecticide treatments and/or biopesticides will be considered by the IMT for trees or shrubs within the infested zone if the outbreak is discovered during the potential adult flight period. They could help to prevent further spread of *A. bungii* in the year that the outbreak is first discovered. However, they are likely only to be beneficial for heavy infestations of the beetle, where there is a high likelihood of further spread, as treatments have the potential to act as repellents to adult beetles.

- Prior to any pesticides being used, the risk posed by the pesticide to people and the environment will be assessed.

- Any applications should be made following the advice on the product label and be in accordance with HSE guidance. In some cases there may be a requirement to carry out a Local Environment Risk Assessment for Pesticides (LERAP) depending on the product used and the situation of the finding

- If there is a finding within a SSSI, Natural England should be contacted to assess the threat of the pesticide application to the site.

5.56. Fruit is not considered to be a major pathway of *A. bungii*. Harvesting of fruit prior to the destruction of trees may therefore be considered by the IMT if the spread of the beetle can be prevented.

5.57. After the clearance of trees in the infested area, trap trees (including within the hedgerow environment) of an appropriate size may be established within this zone to attract and monitor for *A. bungii*. Major hosts of *A. bungii* include peach, apricot, plum and cherry. The trees will be planted in the ground as close as possible to the locations where the infested trees were found, ideally on publicly owned or managed land, but always with the prior consent of the owner or person managing the land. The trees will be inspected for signs of infestation a minimum of twice a year. If signs or symptoms of *A. bungii* are seen, these trees will be destructively sampled.

Disposal plan

5.58. During the *A. bungii* flight period, all felled trees and parts of trees from the infested area should be destroyed/processed as soon as possible after it has been inspected, within a maximum of one week. In Italy, the beginning of the emergence period is May/June in the south and June/July in the north. Options for destruction/processing are:

- Chipping to dimensions of not more than 25 mm in thickness and width. This would be the most appropriate method of disinfesting shrubs, small trees and branches. It may be possible to leave the chipped material in situ but away from footpaths etc. (e.g. where large areas are infested) under an Environment Agency exemption which permits a maximum of 250 cubic metres in any one deposit (check the Environment Agency for current details, similarly for burning - https://www.gov.uk/topic/environmental-management/environmental-permits).

- Burning or incineration. Burning either in situ (under an Environment Agency exemption, which allows a total quantity not exceeding 10 tonnes to be burned in any period of 24 hours) or at a commercial incinerator. NB: it will often not be practical to burn whole trees or large sections, other than those with small diameters e.g. branch wood.

- Moved under containment to a location known and approved by the PHSI or FC. For example, material with no visible signs of infestation could be moved to a new location in *A. bungii* proof containers (e.g. steel shipping containers) and dealt with once conditions are too cool to permit adult activity.

5.59. During the winter, unprocessed logs may be moved out of the infested area under official notice if they are going to a site where they will be processed by one of the following methods before the following flight season:

- Wood chipping – chipping to dimensions of not more than 25 mm in thickness and width.

- Burning or incineration.

5.60. Other methods of disposal, such as deep burial of non-hazardous waste at a local authority approved landfill site, or use as biomass, may be considered on a case-by-case basis.

5.61. In cases where a local authority has the necessary equipment and facilities to carry out the removal and destruction of host material in amenity areas, arrangements may be explored with the authority concerned for the disposal of material from other sources such as private dwellings and commercial premises.

5.62. Any disposal of waste material must be done in accordance with the relevant legislation. Growers need to obtain permission for exemptions from the Agricultural Waste Regulations from the Environment Agency. No charges are made for these exemptions. Further information on activities that require a permit and those which require the registration of an exemption can be found on the EA website at: https://www.gov.uk/topic/environmental-management/environmental-permits.

5.63. Landowners need to ensure that any clearance complies with Habitat Regulations. If needed, permissions can be sought to undertake emergency activities e.g. felling. Further information may be obtained from Natural England or the FC (the latter being the lead authority for all forestry activity).

Replanting

5.64. No host plants will be planted in the demarcated area during the outbreak, except for trap trees.

6. Criteria for declaring eradication / change of policy

6.1. The outbreak will be declared eradicated if the pest is not detected for a period covering at least two lifecycles of *A. bungii,* i.e. a minimum of 8 years.

7. Evaluation and review of the contingency plan

7.1. This pest specific contingency plan should also be reviewed regularly to consider changes in legislation, control procedures, pesticides, sampling and diagnosis methods, and any other relevant amendments.

7.2. Lessons should be identified during and after any outbreak of *A. bungii* or other pest, including what went well and what did not. These should be included in any review of the contingency plan leading to continuous improvement of the plan and response to outbreaks.

8. Appendix A

Data sheet for *Aromia bungii*

Identity

PREFERRED SCIENTIFIC NAME	AUTHOR (taxonomic authority)
Aromia bungii	Faldermann, 1835

CLASS: Insecta

ORDER: Coleoptera

SUBORDER: Polyphaga

SUPERFAMILY: Chrysomeloidea

FAMILY: Cerambycidae

SUBFAMILY: Cerambycinae

SYNONYMS

Aromia bungii subsp. *brunnea* Podaný, 1971

Aromia bungii subsp. *cyanicornis* Guérin-Méneville, 1844

Callichroma bungii Bates, 1888

Callichroma cyanicornis Blanchard, 1871

Callichroma ruficollis Redtenbacher, 1868

Cerambyx bungii Faldermann, 1835

COMMON NAMES

Red neck longhorn beetle (English)

Red-necked longhorn beetle (English)

Peach red necked longhorn (English)

Plum and peach longhorn (English)

Peach longicorn beetle (English)

Peach musk beetle (English)

Peach borer (English)

Asiastischer Moschusbock (German)

Moschusbockkâfer (German)

Cerambice cinese delle drupacee (Italian)

Cerambicide dal collo rosso (Italian)

Notes on taxonomy and nomenclature

The genus *Aromia* Audinet-Serville 1833, is currently represented by 3 species: *Aromia bungii* Faldermann 1835, *A. malayana* Hayashi 1977 and *A. moschata* (Linnaeus, 1758). *Aromia bungii* is a south-east Asian species that has recently been introduced and established populations in parts of Japan and latterly Germany and Italy; *A. malayana,* is recorded only from Malaysia, and *A. moschata* is the most widely distributed and comprises of 6 recognised subspecies distributed through the Palaeartic region. Previous taxonomic structures also included the species *A. japonica*, that is now considered to be a junior synonym of *Chloridolum thaliodes* Bates 1884 (Bentanachs et. al. 2011) and *A. orientalis* Plavilstshikov 1933*,* that is now considered to be one of the 6 subspecies of *A. moschata*, (*A. moschata* subsp. *orientalis*) and is found in south-east Asia (Link 1.).

Biology and ecology

Life history

In the beetle's native range, adults emerge between April and August following a latitudinal gradient moving from the south to the north (CABI, 2017 citing Gressitt, 1942; EPPO, 2014; Ma *et al.*, 2007). Adults subsequently mate and continue to do so throughout their lifetime (CABI, 2017). To locate each other, the beetles utilise aggregation pheromones, as for other cerambycids; Xu *et al.* (2017) recently showed that males of *A. bungii* produce the sex aggregation pheromone (E)-2-cis-6,7-epoxynonenal and that this pheromone was significantly more attractive to both sexes when used to bait traps as compared to traps without the pheromone.

After mating, females lay eggs in batches of 1-6 within the crevices of the bark, preferably inside the trunk within the first 30 cm above ground level, but will also lay eggs further up the trunk and in the bark crevices of branches (Wu and Li, 2005; CABI, 2017). According

to EPPO (2014), older trees are more likely to be infested, and the majority of branches that are attacked are about 10 cm in diameter. Although, beetles have been observed to attack trunks with a diameter of 6 cm in Italy, and attack branches with a diameter of 3 cm in China (EPPO, 2014). Under artificial conditions, Wang *et al.* (2007) recorded females laying an average of 325-357 eggs, and as many as 734 eggs, while EPPO (2014) citing Griffo (pers. comm., 2013), reported females laying an average of 700 eggs, with a maximum of 1200 eggs. The number of eggs laid under natural conditions is not known but is thought to be much less at 30-100 eggs (EPPO, 2014).

Larvae hatch from the eggs in about 10 days and initially bore into the phloem layer, before moving into the sapwood and heartwood (Gressitt 1942; Liu *et al.*, 1999). Galleries can reach 50-60 cm in length, and a copious amount of frass is generated in the process, which is ejected from the gallery usually once per day (Gressitt, 1942; Duffy, 1968; Liu *et al.*, 1999; Wu and Li, 2005; Yu and Gao, 2005; Griffo, 2012). Larvae are active until late autumn and take roughly 2-4 years to develop to maturity, depending on the climate (Yu and Gao, 2005; Ma *et al.*, 2007; Wang *et al.*, 2007; CABI, 2017). Once mature, the larvae excavate a pupal chamber into the heartwood (EPPO, 2015). Pupation generally occurs in spring and lasts about 17-23 days (Ma *et al.*, 2007; Wang *et al.*, 2007).

Wang *et al.* (2007) recorded the lifespan of male and female adults to be 47.5-48.8 days and 53.3-54.3 days, respectively, while EPPO (2015) states a lifespan of just 15-20 days. During this time, adults feed on mature and rotting fruit (CABI, 2017).

Hosts/crops affected

Aromia bungii is an oligophagous xylophile of *Prunus* spp. While the current list of *Prunus* spp. is limited, given that new *Prunus* hosts have been found following its introduction into Germany, Italy and Japan, this list is likely to grow. *Aromia bungii* has also been recorded on other plant species, but these are mostly from compilation host lists without any supporting evidence. An up-to-date host list can be found on the EPPO Global Database - https://gd.eppo.int/taxon/AROMBU/hosts. Although not a recorded host, it should be noted that *Prunus spinosa* (blackthorn) is common, widespread and an important component of many habitats in the UK.

Plant stage affected

Flowering stage, fruiting stage, post-harvest and the vegetative growing stage.

Plant parts affected

Larvae feed within the wood, while adults feed on mature and rotting fruit.

Symptoms/signs - description

Whole plant

Feeding within the trunk and branches can prevent the circulation of sap, weakening the tree and inhibiting fruit production (EPPO, 2014). Early senescence and dieback, and eventually the death of the tree, may also be observed (CABI, 2017).

Trunk and branches

Larvae bore galleries underneath the outer bark and in the sapwood and heartwood of the tree, which can be seen when the bark is removed (Figure 3, CABI, 2017). As the larvae feed, they also produce a copious amount of frass, which can be seen at the base of the tree trunk or on the surface of branches (Figure 3, CABI, 2017). When adults emerge from the pupal chamber and leave the tree, they produce elliptical exit holes (Figure 4, 6-10 x 10-16 mm) (CABI, 2017).

Figure 3. (A) Frass deposited at the base of a peach tree by *A. bungii* larvae. **(B)** Tunnelling within the trunk caused by *A. bungii* larvae. (CABI, 2017)

Figure 4. Exit holes of *A. bungii* (6-10 mm in width, 10-16 mm in length) (CABI, 2017).

Morphology

(Source: CABI, 2017; EPPO, 2015)

Egg: The chorion (outermost membrane) of the egg is yellowish-greenish-whitish. The shape is elongated and sub cylindrical, and the size is about 2 mm long and 1 mm wide. Although, there are records of the egg being up to 6-7 mm in length. © Raffaele Griffo, Plant Protection Service Regione Campania, Napoli, Italy.	

Larva: A newly hatched larva is about 2-2.5 mm long, while a mature larva is about 42-52 mm long. It is yellowish-whitish with blackened tips and bases of mandibles. Two forms of mature larvae have been recognised with one being longer and more slender than the other. © Raffaele Griffo, Plant Protection Service Regione Campania, Napoli, Italy.	
Pupa: Initially whitish-yellowish, but gradually darkens as the immature adult forms. It is generally between 22 and 38 mm and has legs and long coiled antennae. © Raffaele Griffo, Plant Protection Service Regione Campania, Napoli, Italy.	
Adult: Size range 20-40 mm in length, shiny black, usually with a red pronotum, though there is a colour variant *A. bungii* subsp. *cyanicornis* that is entirely black. In both colour variants, both lateral margins of the prothorax bear a single blunt spine or tubercle (small rounded projection). Antennae are longer than the body in males and equal to the length of the body in females. Legs are long and concolourous with the body.	

Similarities to other species/diseases/plant damages

The native *Aromia moschata* is the only other *Aromia* species present in Europe. Two sub-species of *A. moschata*, *A. moschata* subsp. *ambrosiaca*, which is present in Europe but not the UK, and *Aromia moschata* subsp. *orientalis* which occurs in south-east Asia, can also have a red pronotum (CABI, 2017) In addition the subspecies *A. moschata cruenta* (from Kyrgzstan, Tajikistan) and *A. moschata vestuta* (from Turkestan, Kazakhstan) have apartially red pronotum. However, all of these subspecies are easily separable from *A.*

bungii by their distinctive metallic body colouration and rugose elytra that bear two to three raised longitudinal lines (Lompe, 2013).

The symptoms caused by *Aromia bungii* may also be confused with native wood boring insects in the UK, and Malumphy *et al.* (2012) discusses some of these in relation to damage caused by *Anoplophora* beetles, including the large poplar beetle (*Saperda carcharias*) and moths from the Sessidae and Cossidae families.

Detection and inspection methods

Visual inspection is the primary method for detecting infested trees. Surveys should focus on *Prunus* spp. and on trunks and branches with a diameter of 3 cm or more, though preferably with a diameter of 10 cm upwards (EPPO, 2014). Symptoms to look out for include:

- Declining, senescent or decaying trees.
- Frass (reddish sawdust) underneath the tree and on the surface of the branches (EPPO, 2015; CABI, 2017).
- Exit holes in the trunk and branches (roughly 6-10 x 10-16 mm in size) (CABI, 2017).
- Adult beetles, which are easily recognised because of their large size (20-40 mm in length), shiny black appearance and diurnal nature.

To confirm that a tree is infested, destructive sampling is usually required, including the removal of the bark to reveal young larvae and tunnelling, and cutting through the trunk to reveal deeper galleries within the sapwood and heartwood (Ostojá-Starzewski, 2016).

The use of baited traps has been suggested for detecting adults (Gong *et al.*, 2013), and could be used at points of entry, for surveys and at outbreak sites (CABI, 2017). The use of the sex aggregation pheromone (E)-2-cis-6,7-epoxynonenal, in particular, shows promise as a bait (Xu *et al.*, 2017). A bait of sugar, vinegar and wine is also used in Italy with varying degrees of success (EPPO, 2014).

Distribution

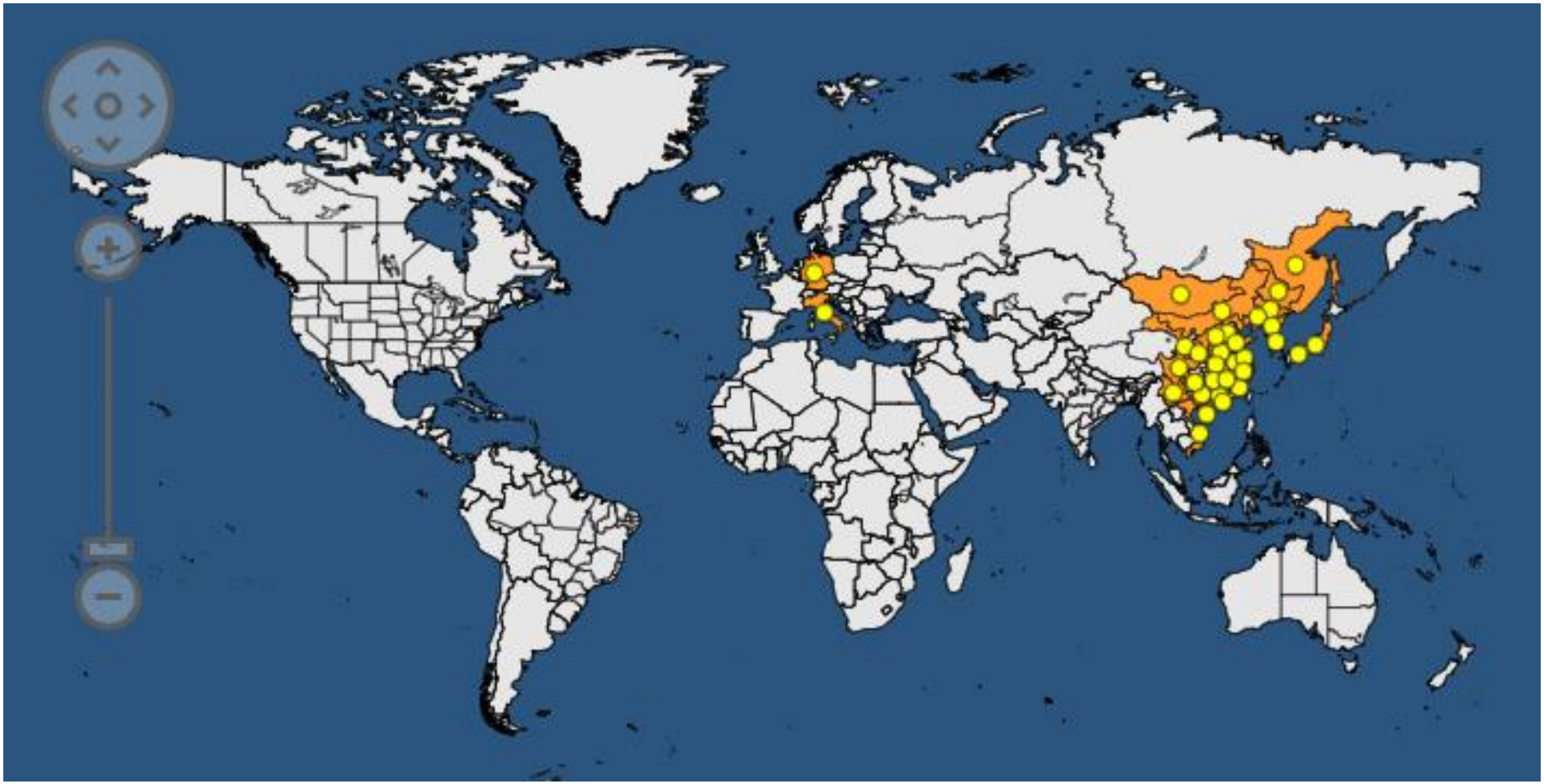

Figure 5. *Aromia bungii* distribution as of September 2021. (Source: EPPO Global database). The link below provides up to date distribution data.

https://gd.eppo.int/taxon/AROMBU/distribution

History of introduction and spread

Aromia bungii is native to eastern Asia (China, the Democratic People's Republic of Korea, the Republic of Korea, Taiwan and Vietnam (CABI, 2017)) and was first intercepted outside of its native range in an empty sea container in Blaine, Washington, USA, in 2007 (EPPO, 2014). In 2008it was detected in Europe for the first time when two live and one dead adult were found amongst imported wooden pallets in a warehouse in Bristol, UK, and again in the USA when a female beetle was found in a manufacturing plant in Seattle, Washington, (Smith, 2009; Anderson *et al.*, 2013).

Japan

In 2013, *A. bungii* was first confirmed to be present in Japan from cherry (*Prunus* spp.) and Japanese apricot trees (*Prunus mume*) in the Aichi prefecture. The beetle has since expanded its range into Tokyo and at least 5 other prefectures (The Japan News, 2017).

Germany

Aromia bungii was first discovered in Germany in 2011, following the finding of the beetle in a damson plum tree in a private garden near Kolbermoor in the south of Bayern (EPPO reporting service, 2012a). The infested tree was cut down and two larvae were subsequently found. As the result of an awareness raising campaign in the local area, that included the distribution of flyers and meetings with the public, a second infested tree was discovered in July 2016 in a private garden in Rosenheim, which was 6 km away from the previous finding (EPPO reporting service, 2017b). A further 26 trees showing signs of infestation were identified in Kolbermoor in October 2016. All the infested trees and trees suspected to be infested were destroyed, and surveys are being conducted in the areas of Rosenheim and Kolbermoor. Movement of plants and wood from these areas has also been restricted.

Italy

In September 2012, *A. bungii* was found for the first time in Italy, in the Campania region, infesting several cherry (*Prunus avium*), plum (*Prunus domestica*) and apricot trees (*Prunus armeniaca*) in parks and gardens (EPPO reporting service, 2012b). A number of actions were taken, including the destruction of the infested trees (as well as the stumps), surveys, awareness raising (posters, videos, TV adverts, meetings etc.) and insecticide treatments used against the adult beetles (EPPO reporting service, 2013a). *Aromia bungii* infestations were subsequently found in about 300 trees in Napoli, Pozzuoli, Marano and Monte di Procida. In August 2013, two adults were found emerging from the wood of a peach tree (*Prunus persica*), which had been felled for firewood, in the municipality of Sedriano, in the Lombardia region (EPPO reporting service, 2013c). The wood was destroyed by chipping. Following an official survey in March 2017, the beetle was found

again in the Campania region, in about 252 apricot and plum trees in the municipalities of Marigliano and Somma Vesuviana (15 km away from the previous finding in the region) (EPPO reporting service, 2017b). There was a new finding in Civitavecchia in the Lazio region in 2020 (EPPO reporting service, 2021). An intensive survey has been carried out and no further infested plants were found but official measures remain in place, with the aim of eradication.

Phytosanitary status

Aromia bungii is a GB Quarantine Pest and an A1 listed pest for the EPPO region and is therefore recommended for regulation by EPPO member countries (EPPO Global Database, 2017).

Table 1. Global phytosanitary categorization of *Aromia bungii*.

Country/NPPO/RPPO	List	Year of addition
AFRICA		
Morocco	Quarantine pest	2018
AMERICA		
Canada	Quarantine pest	2019
Chile	A1 list	2019
EUROPE		
Turkey	A1 list	2016
RPPO		
EAEU	A1 list	2018
EPPO	A1 list	2014
EU	Emergency measures	2018
EU	A2 Quarantine pest	2019

Means of movement and dispersal into the UK

Natural dispersal

There is no data on the natural dispersal of *A. bungii*, apart from the ability of the adult beetles to fly. The dispersal of the beetle is therefore based on that of other cerambycids,

particularly *Anoplophora glabripennis*, which is reported to be capable of flying several kilometres (Smith *et al.*, 2004; Lopez *et al.*, 2017), but more usually spread locally and remains within a few hundred meters of the trees they have emerged from (Smith *et al.*, 2004). While *A. bungii* might be similar, adult beetles may need to travel further to locate hosts, and therefore its spread is potentially greater than *A. glabripennis* (EPPO, 2015).

As the areas where *A. bungii* is known to occur are not located near to the UK geographically, natural dispersal is a very unlikely pathway into the UK.

Movement in trade

Although plants for planting is a potential pathway due to the possible presence of eggs, larvae, pupae and adults, *Prunus* plants (*A. bungii*'s main host) are currently prohibited from third countries excluding EU Member States, Liechtenstein and Switzerland pending a risk assessment. Due to the pests presence in the EU this remains a likely pathway for the pest to enter the UK and should *A. bungii* continue to spread within Italy and further afield in Europe, plants for planting becomes a higher risk pathway (Anderson *et al.*, 2013).

Wood and wood packaging (including finished wood products) is another possible pathway. Late instar larvae and pupae have been shown to survive in logs for months and are likely to be able to complete their lifecycle (EPPO, 2014). Eggs and early stage larvae may also be able to survive for long periods in logs (EPPO, 2014). However, hosts of *A. bungii* are not commonly traded as wood or wood packaging, with the exception of *Populus* spp., such as *Populus alba*, which is an unconfirmed host (Anderson *et al.*, 2013; EPPO, 2014). ISPM 15 also requires that imported WPM is treated to kill wood boring pests. Even so, longhorn beetles have been intercepted from Europe, other Asian countries, Africa, Australasia and the Americas since the introduction of ISPM15, and wood packaging should therefore be considered a risk (Eyre and Haack, 2017).

As previously mentioned, an adult *A. bungii* was found in an empty sea container in Blaine, Washington, USA, in 2007 (EPPO, 2014), and more findings were made amongst wooden pallets in a warehouse in Bristol, UK, and in a manufacturing plant in Seattle, Washington, USA, in 2008 (Smith, 2009; Anderson *et al.*, 2013). In addition, Hitch hiking should therefore also be considered a potential pathway for this beetle.

Control

Cultural controls and sanitary methods

Oviposition by adults can be reduced by covering trunks and branches with anti-insect film, nets or a deterrent mixture of lime, sulphur, salt, animal oil and water (Wen *et al.*, 2010; Gong *et al.*, 2013). Traps baited with sugar, vinegar and wine may also be used to remove adults and reduce oviposition, as well as help to monitor the beetle during its flight period

(CABI, 2017). However, these types of trap are mainly used to attract wood borers that target dead and decaying wood; In Italy, these traps have given variable results, sometimes trapping large numbers of *A. bungii*, and sometimes none (EPPO, 2014).

Once *A. bungii* has infested the tree, it is possible to remove the larvae from galleries using a hooked wire (CABI, 2017). While these methods have shown some value, they are labour intensive and may not be suitable on a large scale (EPPO, 2014).

The only effective method of eradication to date is to destroy the infested plant (EPPO, 2014, 2015; Ostojá-Starzewski, 2016).

Biological control

The entomopathogenic nematode, *Steinernema carpocapsae*, has been used to control the beetle in China (Ostojá-Starzewski *et al.*, 2016). Liu *et al.* (1997) found the nematode to give 58.3-100% mortality of *A. bungii* after one month and nearly 100% mortality across all treatments after 8 months under laboratory conditions. Liu *et al.* (1998) later showed the nematode to give effective control under field conditions on apricot and peach. However another species of entomopathogenic nematode*, Steinernema longicaudum* was not found to be effective (Liu *et al.*, 1998).

The beetle, *Dastarcus helophoroides*, and the parasitoid, *Scleroderma guani*, have also been used to positive effect in China alongside entomopathogenic nematodes (Gong *et al.*, 2013) to control longhorn beetles. In a study by Li *et al.* (2009), *D. helophoroides* was shown to be effective in killing *A. bungii* when placed in plastic tubes above larval galleries in peach and ornamental trees. A later study by Men *et al.* (2017) identified that the origin of the *D. helophoroides* had a significant impact on the ability of the beetle to kill *A. bungii*; with beetles collected in association with *Anoplophora glabripennis*, *Batocera horsfieldi* and *Monochamus alternatus* caused greater mortality of *A. bungii* than those collected in association with *Neocerambyx raddei* and *Apriona swainsoni*, whilst those collected in association with *Anoplophora chinensis* showed no better ability to kill *A. bungii* than the controls.

Fungi may also provide some control of *A. bungii*. A spent culture broth of the fungus, *Lepiota helveola*, was effective in controlling the egg and larval stages of the beetle, giving 84.2 and 68.5% mortality, respectively (Hong and Yang, 2010). Culture homogenates in 5-20% aqueous solution were also tested against *A. bungii*, and while giving control of larvae (33.9-87.5%), they did not have an effect on the eggs (Hong and Yang, 2010).

Chemical control

Because larvae and pupae develop inside the wood, they are difficult to control with foliar insecticides. Adults are also difficult to control, as they have a long flight period over which sprays must be applied. However, in some countries foliar insecticides are still used on the tree canopy and trunks to kill adults, and eggs and larvae as they hatch, (Zhang *et al.*,

2000). Insecticide coated cloths can also be placed into emergence holes (EPPO, 2014). Chemicals used include organophosphates, pyrethroids and neonicotinoids (CABI, 2017). A full list of chemicals that may be effective are given in EPPO (2014).

CABI (2017) report that tree injections using organophosphates have given high mortality. However, EPPO (2014) suggests they are not completely effective and are likely to be used only for prevention purposes, referencing the unsuitability of tree injection for the eradication of *Anoplophora* beetles. Fumigation is another technique that could be used to kill larvae and pupae inside the wood (EPPO, 2014; CABI, 2017).

In addition, Celangulins swab (antifeedant) gave 72.08% mortality of *A. bungii* in a study by Chen (2009).

Impacts

Economic impact

Aromia bungii causes considerable damage to fruit trees, such as peach, apricot, plums and cherries, in China; Liu *et al.* (1997), recorded damage from 30-100% of trees following a survey of fruit orchards, and Zhang *et al.* (2017) found *A. bungii* to cause serious damage to Rosaceae trees in an orchard in Delisi township, Wafangdian City, Lianong Province. Although many authors suggest that *A. bungii* prefers old, stressed and decaying trees, young and healthy trees have been readily attacked in Italy (EPPO, 2014). The damage caused by *A. bungii* reduces fruit yields and, in severe cases, can kill trees (EPPO, 2014).

Environmental impact

Urban trees, including *Prunus* trees, contribute to several ecosystem services, including microclimate amelioration (mainly evapotranspiration-cooling effects), carbon dioxide sequestration, oxygen generation, and the removal of gaseous and particulate pollutants (Jim and Chen, 2009). Such benefits are lost if trees are killed or cut down and remain lost until equivalent sized trees can replace them. As a result of the damage caused by *A. bungii*, 20 trees lining a path at the Kasai reservoir in Soka, Saitama Prefecture, in Japan, were cut down (The Japan News, 2017). Further infestation was found in urban areas along the Tamagawa River, Tokyo, when 40% (~ 60) of trees of 150 surveyed were found with frass, and this may lead to the loss of further urban trees (The Japan News, 2017).

Loss of trees in more natural environments can give rise to soil instability and increase the risk of erosion and fire, loss of habitat and impact native fauna that utilise these hosts. *Aromia bungii* is considered a pest of forest *Prunus* (Yang and Chen, 1999; Wen *et al.*, 2010) and has the potential to cause the loss of these habitats. Several *Prunus* spp. are also listed as vulnerable, endangered or critically endangered on the International Union

for Conservation of Nature (IUCN) Red List (IUCN, 2017) and are at risk of extinction should *A. bungii* continue to spread.

Social impact

The loss of trees resulting from infestation would negatively affect recreational and amenity sites, and could potentially reduce tourism, as could be the case for cherry-blossom viewing sites in Japan, where cherry trees have been reported as being weakened (The Japan News, 2017). Other potential social impacts include injury resulting from fallen weakened trees in urban areas, the loss of employment through reduced orchard production and the loss of *Prunus* in private gardens (Anderson *et al.*, 2013; EPPO, 2014).

9. References

Anderson, H., Korycinska, A., Collins, D., Matthews-Berry, S. and Baker, R. (2013) Rapid pest risk analysis for *Aromia bungii* [Online]. Available: https://secure.fera.defra.gov.uk/phiw/riskRegister/downloadExternalPra.cfm?id=3818. Accessed: 19/12/2017.

Bense, U. (1995) Longhorn Beetles: Illustrated Key to the Cerambycidae and Vesperidae of Europe. Magraf. 512 pp.

Bentanachs, J., Niisato, T. and Ohbayashi, N. (2011) Synonymic Notes on Callichromatine Species (Coleoptera, Cerambycidae, Cerambycinae) Described from Japan. Elytra, Tokyo, New Series. 1, 125:129.

Booth, R. G., Cox, M. L. and Madge, R. B. (1990) IIE guides to insects of importance to man. 3. Coleoptera. Wallingford, UK, CAB International. 384 pp.

Biolib (2017) *Aromia bungii* Faldermann, 1835 [Online]. Available: https://www.biolib.cz/en/taxon/id221256/. Accessed: 21/12/2017.

Burmeister, E. G., Hendrich, L. and Balke, M. (2012) Der Asiatische Moschusbock Aromia bungii (Faldermann, 1835) – Erstfund für Deutschland (Coleoptera: Cerambycidae). Nachrichtenblatt der bayerischen Entomologen. 61, 29-32.

Byun, B. K., Lee, B. W., Park, S. Y., Lee, Y. M. and Jo, D. G. (2009) Insect fauna of Mt. Nam-san in Seoul, Korea. Journal of Korean Nature. 2, 137-153.

CABI (2017) *Aromia bungii* (red necked longicorn) [Online]. Available: https://www.cabi.org/cpc/datasheet/118984. Accessed: 18/12/2017.

Chen, J. *et al.* (2009) Preparation botanical insecticide celangulins swab and its efficacy test on trunk borer. Journal of Anhui Agricultural Sciences. 37, 7529-7530.

Duff, A.G. (2012) Beetles of Britain and Ireland. Vol. 1: Sphaeriusidae to Silphidae to Curculionidae. A.G. Duff Publishing. 496 pp. ISBN 978-0-9573347-0-0

Duffy, E. A. J. (1968) A monograph of the immature stages of oriental timber beetles (Cerambycidae). British Museum, Natural History, editor, London: 434 pp.

EPPO (2014) Pest risk analysis for *Aromia bungii* [Online]. Available: https://www.eppo.int/QUARANTINE/Pest_Risk_Analysis/PRAdocs_insects/15-21043_PRA_record_Aromia_bungii.pdf. Accessed: 18/12/2017.

EPPO (2015) *Aromia bungii*. EPPO Bulletin. 45, 4-8.

EPPO reporting service (2012a) First report of *Aromia bungii* in Germany: addition to the EPPO Alert List [Online]. Available: https://gd.eppo.int/reporting/article-1917. Accessed: 21/12/2017.

EPPO reporting service (2012b) First report of *Aromia bungii* in Italy [Online]. Available: https://gd.eppo.int/reporting/article-2410. Accessed: 21/12/2017.

EPPO reporting service (2013a) Update on the situation of *Aromia bungii* in Campania (IT) [Online]. Available: https://gd.eppo.int/reporting/article-2410. Accessed: 20/12/2017.

EPPO reporting service (2013b) First report of *Aromia bungii* in Japan [Online]. Available: https://gd.eppo.int/reporting/article-2650. Accessed: 21/12/2017.

EPPO reporting service (2013c) *Aromia bungii* found for the first time in Lombardia region, Italy [Online]. Available: https://gd.eppo.int/reporting/article-2649. Accessed: 21/12/2017.

EPPO reporting service (2017a) *Aromia bungii* found again in Bayern, Germany [Online]. Available: https://gd.eppo.int/reporting/article-6024. Accessed: 21/12/2017.

EPPO reporting service (2017b) Update on the situation of *Aromia bungii* in Italy [Online]. Available: https://gd.eppo.int/reporting/article-6136. Accessed: 21/12/2017.

EPPO reporting service (2021). Update on the situation of *Aromia bungii* in Italy. [Online]. Available: https://gd.eppo.int/reporting/article-6974

EPPO Global Database (2017) *Aromia bungii* [Online]. Available: https://gd.eppo.int/taxon/AROMBU. Accessed: 20/12/2017.

EUNIS (2012) EUNIS Habitat Classification [Online]. Available: https://www.eea.europa.eu/data-and-maps/data/eunis-habitat-classification. Accessed: 12/01/2018.

Eyre, D. and Haack, R. A. (2017) Invasive Cerambycid Pests and Biosecurity Measures. In Q. Wang (ed.) Cerambycidae of the world: biology and pest management. Boca Raton, FL: CRC Press, pp. 563-607.

Gong, Q., Huang, A., Tang, Y. and Xiong, J. (2013) Summary of IPM of *Aromia bungii* Faldermann. Biological Disaster Science. 36, 430-433.

Gressitt, J. L. (1942) Destructive long-horned beetle borers at Canton, China. Special Publication 1. Lingnan Natural History Survey and Museum, Lingnan University, Canton, China: 1-60.

Gressitt, J. L. (1951) Longicorn Beetles of China. Longicornia. 2, 1-667.

Griffo, R. (2012) Le signalazioni di *Aromia bungii*. PowerPoint presentation. 26pp.

Hong, N. and Yang, S. (2010) Biological control of *Aromia bungii* by *Lepiota helveola* spent culture broth and culture homogenates. Acta Edulis Fungi. 17, 67-69.

Hua, L. Z., Nara, H. and Yu, C. (1993) Longicorn-Beetles of Hainan & Guangdong. Nantou Hsien, Taiwan: Muh-Sheng Museum of Entomology Publisher. pp. 319

IUCN (2017) The IUCN Red List of Threatened Species [Online]. Available: http://www.iucnredlist.org/. Accessed: 12/01/2018.

Jim, C. Y. and Chen, W. Y. (2009) Ecosystem services and valuation of urban forests in China. Cities. 26, 187-194.

KKI (2012) Express PRA zu *Aromia bungii* by Schrader G and Schröder T. (in German) [Online]. Available: http://pflanzengesundheit.jki.bund.de/dokumente/upload/0ec1b_aromia_bungii-ex-pra.pdf. Accessed: 21/12/2017.

Kolbe, H. J. (1886) Beiträge zur Kenntnis der Coleopteren-Fauna Koreas. Archiv für Naturgeschichte. 1, 139-240.

Lee, S. M. (1982) Longicorn beetles of Korea (Coleoptera: Cerambycidae). Insecta Koreana.1, 1-85.

Lim, J., Jung, S. Y., Lim, J. S., Jang, J., Kim, K. M., Lee, Y. M. and Lee, B. W. (2014) A review of host plants of Cerambycidae (Coleoptera: Chrysomeloidea) with new host records for fourteen cerambycids, including the Asian longhorn beetle (*Anoplophora glabripennis* Motschulsky), in Korea. Korean Journal of Applied Entomology. 53, 111-133.

Li, M., Li, Y., Lei, Q. and Yang, Z. (2009) Biocontrol of Asian longhorned beetle larva by releasing eggs of *Dastarcus helophoroides* (Coleoptera: Bothrideridae). Scientia Silvae Sinicae. 45, 78-82.

Link 1. Old World Cerambycid Catalog [Online]. Available: https://apps2.cdfa.ca.gov/publicApps/plant/bycidDB/wdefault.asp?w=o. Accessed: 06/04/2019.

Liu, Q., Wang, Y., Tong, F., Zhang, W. and Xu, L. (1998) Study on application techniques of *Steinernema* nematodes against RNL. Journal of China Agricultural University. 3, 17-21.

Liu, Q., Wang, Y. and Zhou, H. (1997) Application of entomopathogenic nematodes for controlling larvae of RLB. Acta Agrictulrae Boreali-Sinica. 12, 97-101.

Liu, Q., Wang, Y. and Zhou, J. (1999) Biology of RNL's boring trunk and expelling frass. Journal of China Agricultural University. 4, 87-91.

Lopez, V. M., Hoddle, M. S., Francese, J. A., Lance, D. R., Ray, A. M. (2017) Assessing flight potential of the invasive Asian longhorned beetle (Coleoptera: Cerambycidae) with computerized flight mills. Journal of Economic Entomology. 110, 1070-1077.

Ma, W., Sun, L., Yu, L., Wang, J. and Chen, J. (2007) Study on the occurrence and life history in *Aromia bungii* (Faldermann). Acta Agriculturae Boreali Sinica. 22, 247-249.

Malumphy, C., Korycinska, A., Ostojá-Starzewski, J. C., (2012). Differentiating *Anoplophora* longhorn beetle damage from that of native wood-boring insects. [Online]. Available from: https://planthealthportal.defra.gov.uk/assets/factsheets/anplophoraLonghornBeetle.pdf

Men, J., Cao, D-D., Zhao, B., Wang, W-C., Liu, P-C., Wei, J-R. (2017) Behavorial responses of adults of *Dastarcus helophoroides* (Coleoptera: Bothrideridae) populations originated from different hosts to larval frass of *Aromia bungii* (Coleoptera Cerambycidae) and their control effect on *A. bungii* population. Acta Entomologica Sinica. 60, 229-236.

Okamoto, H. (1927) The longicorn beetles from Korea. Insecta Matsumura. 2, 62-86.

Ostojá-Starzewski, J. C. (2016) Red-necked longhorn beetle *Aromia bungii* (revised May 2017 by C. Malumphy (Fera), D. Eyre and H. Anderson (Defra)) [Online]. Available at: https://planthealthportal.defra.gov.uk/assets/factsheets/Aromia-bungii-Defra-PP-Factsheet-May-2017-2.pdf. Accessed: 09/01/2018.

Pei'En, X. (2007) Coloured illustrations of longhorned beetles in Mongolian Plateau. Beijing. pp. 149.

Smith, M. T., Tobin, P. C., Bancroft, J., Li, G. and Gao, R. (2004) Dispersal and spatiotemporal dynamics of Asian longhorned beetle (Coleoptera: Cerambycidae) in China. Environmental Entomology. 33, 435–442.

Roselli, A., Bianchi, A., Nuccitelli, L., Perverieri Sabbatini, G. and Roversi, P. (2013). Control strategies of *Anoplophora chinensis* in an area of considerable artistic and archaeological value in Rome. Journal of Entomological and Acarological Research. 45, 27-29.

Smith, J. W. (2009) NPAG report: *Aromia bungii* (Faldermann): Redneck Longhorned Beetle Coleoptera / Cerambycidae. New Pest Advisory Group (NPAG), Plant Epidemiology and Risk Analysis Laboratory, Center for Plant Health Science & Technology, APHIS, USDA.

Straw, N. A., Fielding, N. J., Tilbury, C., Williams, D. T. and Cull, T. (2016) History and development of an isolated outbreak of Asian longhorn beetle *Anoplophora glabripennis* (Coleoptera: Cerambycidae) in southern England. Agricultural and Forest Entomology. 18, 280-293.

The Japan News (2017) Sakura trees endangered by beetles. *News article no longer available online.

van der Gaag, D. J., Sinata, G., Roversi, P. F., Loomans, A., Herard, F. and Vukadin, A. (2010) Evaluation of eradication measures against *Anoplophora chinensis* in early stage infestations in Europe. EPPO Bulletin. 40, 176-187.

Wang, J. T., Sun, L. W., Liu, T. Z. and Zhang, L. Y. (2007) Research on the occurrence character and control measure of *Aromia bungii*. Journal of Hebei Agricultural Sciences. 11, 41-43, 79.

Wen, H. R., Yu, S-Y., Chu, J-Y. (2010) Technology of prevention and control of major pests and diseases of stone economic forests. Journal of Liaoning Forestry Science & Technology. 3, 54-55.

Wu, J. and Li, Y. (2005) Chapter 14. Branch borers: China teaching syllabus of Northwest A & F University. A & F University, Yangling, Shaanxi Province.

Xu, T., Yasui, H., Teale, S. A., Fujiwara-Tsujii, N., Wickham, J. D., Fukaya, M., Hansen, L., Kiriyama, S., Hao, D., Nakano, A., Zhang, L., Watanabe, T., Tokoro, M. and Millar, J. G. (2017) Identification of a male-produced sex-aggregation pheromone for a highly invasive cerambycid beetle, *Aromia bungii*. Scientific Reports. 7, 7330.

Yang, H. W. and Chen, S. (1999) Utilization of entomogenous nematodes for control of insect pests. Scientia Silvae Sinicae. 35, 103-109.

Yu, G. P. and Gao, B. N. (2005) Bionomics of *Aromia bungii*. Forest Pest and Disease. 24, 15-16.

Zhang, X., Zeng, C. and Zhang, J. (2000) Bionomics and control techniques of *Aromia bungii*. Forest Pest and Disease. 2, 9-11.

Zhang, Y-R., Wang, R., Yu, Y. and Luo, Y-Q. (2017) Damage and population dynamics of wood-boring cerambycid beetles in rosaceous fruit trees. Chinese Journal of Applied Entomology. 54, 500-505.

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